

## Statistics Graduate Courses

STAT 7002--Topics in Statistics-Biological/Physical/Mathematics (cr.arr.).Organized study of selected topics. Subjects and earnable credit may vary from semester to semester. Repeatable with departmental consent. Prerequisites: graduate standing and instructor's consent.

STAT 7020--Statistical Methods in the Health Sciences (3).Basic inference methods, both parametric and non-parametric, appropriate for answering questions arising in health sciences research. Computer exercises involving data from real experiments from health science area. Prerequisite: MATH 1100 or 1120 and graduate standing or instructor's consent.

STAT 7050--Connecting Statistics to Middle and Secondary Schools (3).Primarily for middle and secondary mathematics education majors. Uses standards-based curricular materials to demonstrate connections between college-level statistics and content taught in middle and secondary schools. No credit toward a graduate degree in statistics. Prerequisite: graduate standing and an introductory course in statistics or MATH 2320 or instructor's consent.

STAT 7070--Statistical Methods for Research (3).Designed for graduate students who have no previous training in statistics. Topics include descriptive statistics, probability distributions, estimation, hypothesis testing, regression, and ANOVA. No credit toward a degree in statistics. Prerequisites: graduate standing and either MATH 1100 or 1120.

STAT 7085--Problems in Statistics for Non-majors (cr.arr.).Approved reading and study, independent investigations, and reports on approved topics. Prerequisites: graduate standing and instructor's consent.

STAT 7110--Statistical Software and Data Analysis (3).Programming with major statistical packages emphasizing data management techniques and statistical analysis for regression, analysis of variance, categorical data, descriptive statistics, non-parametric analyses, and other selected topics. Prerequisite: graduate standing and STAT 3500, 7070, 4710/7710, 4760/7760, or instructor's consent.

STAT 7150--Applied Categorical Data Analysis (3).The study of statistical models and methods used in analyzing categorical data. The use of computing is emphasized and calculus is not required. No credit for students who have previously completed STAT 4830. No credit toward a graduate degree in statistics. Prerequisites: graduate standing; STAT 3500, 7070, 4710/7710, or 4760/7760 or instructor's consent.

STAT 7210--Applied Nonparametric Methods (3).Statistical methods when the functional form of the population is unknown. Applications emphasized. Comparisons with parametric procedures. Goodness of-fit, chi-square, comparison of several populations, measures of correlation. Prerequisite: graduate standing and STAT 3500, 7070, 4710/7710, 4760/7760, or instructor's consent.

STAT 7310--Sampling Techniques (3).Theory of probability sampling designs. Unrestricted random sampling. Stratified sampling. Cluster sampling. Multistage or sub sampling. Ratio estimates.

Regression estimates. Double sampling. Prerequisites: graduate standing STAT 3500, 7070, 4710/7710, 4760/7760, or instructor's consent.

STAT 7410--Biostatistics (3). Study of statistical techniques for the design and analysis of clinical trials, laboratory studies and epidemiology. Topics include randomization, power and sample size calculation, sequential monitoring, carcinogenicity bioassay and case-cohort designs. Prerequisite: graduate standing and STAT 3500, 7070, 4710/7710, 4760/7760, or instructor's consent.

STAT 7420--Applied Survival Analysis (3). Parametric models; Kaplan-Meier estimator; nonparametric estimation of survival and cumulative hazard functions; log-rank test; Cox model; Stratified Cox model; additive hazards model partial likelihood; regression diagnostics; multivariate survival data. Prerequisite: STAT 3500, STAT 7070, STAT 4710/7710 or STAT 4760/7760 or instructor's consent.

STAT 7430--Applied Longitudinal Data Analysis (3). Repeated measurements; event history studies; linear and nonlinear mixed effects models; growth models; marginal mean and rate models; pattern-mixture models; selection models; non-informative and informative drop-out; joint analysis of longitudinal and survival data. Prerequisites: STAT 3500, STAT 7070, STAT 4710/7710, or STAT 4760/7760 or instructor's consent.

STAT 7450--Applied Statistical Methods for Bioinformatics (3). Random variables; Point estimation; Multiple t-test; Likelihood principle; Analysis of variance; Probabilistic methods for sequence modeling; Gene expression analysis; Protein structure prediction; Genome analysis; Hierarchical clustering and Gene classification. Prerequisites: graduate standing and STAT 3500, 7070, 4710/7710, 4760/7760, or instructor's consent.

STAT 7510 - Applied Statistical Models I (3). Introduction to applied linear models including regression (simple and multiple, subset selection, estimation and testing) and analysis of variance (fixed and random effects, multifactor models, contrasts, multiple testing). No credit toward a graduate degree in statistics. Prerequisite: graduate standing and Statistics [STAT] 3500, 7070, 4710/7710, 4760/7760, or instructor's consent.

STAT 7530--Analysis of Variance (3). Study of analysis of variance and related modeling techniques for cases with fixed, random, and mixed effects. Exposure to designs other than completely randomized designs including factorial arrangements, repeated measures, nested, and unequal sample size designs. Prerequisite: graduate standing and STAT 3500, 7070, 4710/7710, 4760/7760, or instructor's consent.

STAT 7540--Experimental Design (3). Examination and analysis of modern statistical techniques applicable to experimentation in social, physical or biological sciences. Prerequisites: STAT 4530/7530.

STAT 7560--Applied Multivariate Data Analysis (3). Testing mean vectors; discriminant analysis; principal components; factor analysis; cluster analysis; structural equation modeling; graphics. Prerequisites: STAT 3500, STAT 7070, STAT 4710/7710 or STAT 4760/7760. No credit toward a graduate degree in statistics.

STAT 7610--Applied Spatial Statistics (3). Introduction to spatial random processes, spatial point patterns, kriging, simultaneous and conditional autoregression, and spatial data analysis. Prerequisites: STAT 4510/7510 or instructor's consent. Recommended: Basic knowledge of calculus and matrices.

STAT 7640--Introduction to Bayesian Data Analysis (3). Bayes formulas, choices of prior, empirical Bayesian methods, hierarchical Bayesian methods, statistical computation, Bayesian estimation, model selection, predictive analysis, applications, Bayesian software. Prerequisites: graduate standing; STAT 3500 or 4510/7510 or instructor's consent.

STAT 7710--Introduction to Mathematical Statistics (3). (same as Mathematics 7315). Introduction to theory of probability and statistics using concepts and methods of calculus. Prerequisites: graduate standing and MATH 2300 or instructor's consent. No credit MATH 7315.

STAT 7750--Introduction to Probability Theory (3). (same as Mathematics 7320). Probability spaces; random variables and their distributions; repeated trials; probability limit theorems. Prerequisites: graduate standing and MATH 2300 or instructor's consent.

STAT 7760--Statistical Inference (3). (same as Mathematics 7520). Sampling; point estimation; sampling distribution; tests of hypotheses; regression and linear hypotheses. Prerequisite: STAT 4750/7750 or instructor's consent.

STAT 7810--Nonparametric Methods (3). A first course in Non-parametric statistical methods based on ranks. Both theory and application are emphasized. Two-sample problems. K-sample problems. Tests for independence. Contingency tables. Goodness-of-fit tests. Prerequisite: graduate standing and STAT 4710/7710 or instructor's consent.

STAT 7830--Categorical Data Analysis (3). Discrete distributions, frequency data, multinomial data, chi-square and likelihood ratio tests, logistic regression, log linear models, rates, relative risks, random effects, case studies. Prerequisites: graduate standing and STAT 4710/7710 or instructor's consent.

STAT 7850--Introduction to Stochastic Processes (3). Study of random processes selected from: Markov chains, birth and death processes, random walks, Poisson processes, renewal theory, Brownian motion, Gaussian processes, white noise, spectral analysis, applications such as queuing theory, sequential tests. Prerequisite: graduate standing and STAT 4750/7750 or instructor's consent.

STAT 7870--Time Series Analysis (3). A study of univariate and multivariate time series models and techniques for their analyses. Emphasis is on methodology rather than theory. Examples are drawn from a variety of areas including business, economics and soil science. Prerequisites: graduate standing STAT 7710 or 7760 or instructor's consent.

STAT 8085--Problems in Statistics for Majors - Masters (cr.arr.). Approved reading and study, independent investigations, and reports on approved topics. Prerequisites: graduate standing and instructor's consent.

STAT 8090--Master's Thesis Research in Statistics (cr.arr.). Graded on a S/U basis only.

STAT 8100--Special Topics in Statistics (cr.arr.). Prerequisite: instructor's consent.

STAT 8220 - Applied Statistical Models II (3). Advanced applied linear models including mixed linear mixed models (fixed and random effects, variance components, correlated errors, split-plot designs, repeated measures, heterogeneous variance), generalized linear models (logistic and Poisson

regression), nonlinear regression. No credit toward a graduate degree in statistics. Prerequisites: Statistics [STAT] 4510/7510 or instructor's consent. Graduate standing required.

STAT 8310--Data Analysis I (3).Applications of linear models including regression (simple and multiple, subset selection, regression diagnostics), analysis of variance (fixed, random and mixed effects, contrasts, multiple comparisons) and analysis of covariance; alternative nonparametric methods. Prerequisite: STAT 4710/7710 or 4760/7760 or instructor's consent.

STAT 8320--Data Analysis II (3).Advanced applications including analysis of designs (e.g. repeated measures, hierarchical models, missing data), multivariate analysis (Hotelling's T<sup>2</sup>, MANOVA, discriminant analysis, principal components, factor analysis), nonlinear regression, generalized linear models, categorical data analysis. Prerequisite: STAT 8310 or instructor's consent.

STAT 8370--Statistical Consulting (3).Participation in statistical consulting under faculty supervision. Formulation of statistical problems. Planning of surveys and experiments. Statistical computing. Data analysis. Interpretation of results in statistical practice. Prerequisites: STAT 4760/7760 and 8320 or instructor's consent.

STAT 8410--Statistical Theory of Bioinformatics (3).Study of statistical theory and methods underpinning bioinformatics. Topics include statistical theory used in biotechnologies such as gene sequencing, gene alignments, microarrays, phylogenetic trees, evolutionary models, proteomics and imaging. Prerequisite: STAT 4760/7760.

STAT 8640--Bayesian Analysis I (3).Bayes' theorem, subjective probability, non-informative priors, conjugate prior, asymptotic properties, model selection, computation, hierarchical models, hypothesis testing, inference, predication, applications. Prerequisites: STAT 4760/7760 and MATH 4140/7140 or instructor's consent.

STAT 9085--Problems in Statistics for Majors - PhD (cr.arr.).Approved reading and study, independent investigations, and reports on approved topics. Prerequisites: graduate standing and instructor's consent.

STAT 9090--Doctoral Dissertation Research in Statistics (cr.arr.).Graded on a S/U basis only.

STAT 9100--Recent Developments in Statistics (3).The content of the course which varies from semester to semester, will be the study of some statistical theories or methodologies which are currently under development, such as bootstrapping, missing data, non-parametric regression, statistical computing, etc. Prerequisites: STAT 4760/7760 and instructor's consent.

STAT 9250--Statistical Computation and Simulation (3).Random number generation, acceptance/rejection methods; Monte Carlo; Laplace approximation; the EM algorithm; importance sampling; Markov chain Monte Carlo; Metropolis-Hasting algorithm; Gibbs sampling, marginal likelihood. Prerequisites: STAT 4760/7760 or instructor's consent. Graduate standing.

STAT 9310--Theory of Linear Models (3).Theory of multiple regression and analysis of variance including matrix representation of linear models, estimation, testing hypotheses, model building, contrasts, multiple comparisons and fixed and random effects. Prerequisites: STAT 4760/7760 and MATH 4140/7140, and instructor's consent.

STAT 9320--Advanced Linear Models (3).Advanced topics in the theory and application of linear models. Specific content varies with instructor. Prerequisites: STAT 9310 or instructor's consent.

STAT 9370--Multivariate Analysis (3).Distribution of sample correlation coefficients. Derivation of generalized T-squared and Wishart distributions. Distribution of certain characteristic roots, vectors. Test of hypotheses about covariance matrices and mean vectors. Discriminant analysis. Prerequisites: STAT 4760/7760 and MATH 4140/7140 or instructor's consent.

STAT 9410--Survival Analysis (3).Statistical failure models, Kaplan-Meier estimator, Log-rank test, Cox's regression model, Multivariate failure time date analysis, Counting process approaches. Prerequisites: STAT 4760/7760 or instructor's consent.

STAT 9510--Theory of Nonparametric Statistics (3).Estimation, hypothesis testing, confidence intervals, etc., when functional form of the population distribution is unknown. Prerequisites: STAT 4760/7760 or instructor's consent.

STAT 9530--Data Mining and Machine Learning Methods (3).Approaches to estimating unspecified relationships and findings unexpected patterns in high dimensional data. Computationally intensive methods including splines, classifications, tree-based and bagging methods, support vector machines. Prerequisites: Stat 4110/7110, 4760/7760 and 8320 or instructor's consent.

STAT 9640--Bayesian Analysis II (3).Likelihood principle, decision theory, asymptotic properties, advanced topics in Bayesian analysis at the instructor's discretion. Prerequisites: STAT 8640 and 9710 or instructor's consent.

STAT 9710--Mathematical Statistics I (3).Theory of estimation and tests of hypotheses including sufficiency, completeness and exponential families. Neyman-Pearson lemma, most powerful tests, similarity and invariance. Bayes and minimum variance unbiased estimates. Confidence intervals and ellipsoids. Prerequisite: STAT 4760/7760 or instructor's consent.

STAT 9720--Mathematical Statistics II (3).Asymptotic distributions of maximum likelihood estimators, chi-square and likelihood ratio test statistics. EM algorithm, bootstrap, and introduction to generalized linear models. Prerequisites: STAT 9710, MATH 4700/7700 or instructor's consent.

STAT 9810--Advanced Probability (3).(same as Mathematics 8480). Measure theoretic probability theory. Characteristic functions; conditional probability and expectation; sums of independent random variables including strong law of large numbers and central limit problem. Prerequisites: STAT 4750/7750 or MATH 4700/7700 or instructor's consent.

STAT 9820--Stochastic Processes (3).(same as Mathematics 8680). Markov processes, martingales, orthogonal sequences, processes with independent and orthogonal increments, stationary, linear prediction. Prerequisite: STAT 9810 or instructor's consent.